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IN THE INTEREST OF THE HOROLOGICAL AND JEWELRY INDUSTRY

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Vol. V DECEMBER, 1940 No. 12

The American Horologist

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THE AMERICAN HOROLOGIST

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This year, more than ever before, we hope that your Christmas will be merry; merry with appreciation for the good fortune of all Americans, merry with the prosperity of the business we trust you will enjoy, merry with the feeling of friendliness and fellowship which the Yule-tide season always affords

To Jewelers and Watchmakers everywhere Swartchild & Company wishes, for the 71st time, a Very Merry Christmas.

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You, who are readers, advertisers, contributors of material, and all, have made U.H.A.A. and THE AMERICAN HOROLOGIST possible and what it is today—the strongest and largest organization in the Industry and our paper the largest circulation in the Horological field.

U.H.A.A. is proud of its attainments which were acquired in the face of tremendous odds. U.H.A.A. shows greater strength today because it represents all classes with a primary objective—"Help one another to greater proficiency." No class divisions, one for all and all for one. Unity, cooperation and reciprocity with all branches of our industry.

THE AMERICAN HOROLOGIST enters its Sixth year. Our January, 1941 issue will be our Anniversary number, packed with aids to all, especially to those seeking Legislation. Circulation will be doubled so as to carry these valuable messages.

Again, we say in all sincerity—Merry Christmas and a most prosperous 1941 from the officers of U.H.A.A., and THE AMERICAN HOROLOGIST.

ORVILLE R. HAGANS,
National Executive Secretary & Editor.

YOU ARE URGED TO MAKE ARRANGEMENTS NOW TO BE THE GUEST OF DULUTH MINN. DURING U. H. A. A. SEVENTH ANNUAL NATIONAL CONVENTION JUNE 22-23-24 1941

READ THIS . . . . . .

which was unsolicited. It came from H. C. Carpenter, Watch Inspector, Russellville, Arkansas.

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Fitting Balance Springs

By HAROLD C. KELLY
Member National Technical Board

In fitting balance springs the first procedure is to determine the number of vibrations of the balance per minute. This may be found in any watch fitted with a second hand by first dividing the number to teeth in the fourth wheel by the number of leaves in the escape pinion. Then by multiplying the quotient by twice the number of teeth in the escape wheel, we have ascertained the number of vibrations of the balance per minute.

For example, the fourth wheel has 80 teeth; the escape pinion has 8 leaves; the escape wheel has 15 teeth.

$$\frac{80 \times 30}{8} = 300$$

Other examples are as follows:

$$\frac{72 \times 30}{8} = 270 \text{ vibration per minute}$$

$$\frac{64 \times 30}{8} = 240 \text{ vibrations per minute}$$

In watches where the fourth wheel does not register seconds we have to go back to the center wheel as shown in the following examples:

$$\frac{54 \times 50 \times 48 \times 30}{6 \times 6 \times 6} = 18{,}000 \text{ vibrations per hour}$$

$$\frac{64 \times 66 \times 60 \times 30}{8 \times 8 \times 6} = 19{,}800 \text{ vibrations per hour}$$

Fitting a Flat Spring

To select a balance spring that would be approximately the correct strength, it is only necessary to stake the collet on the staff and hold the spring with the tweezers at the coil roughly indicating the full diameter desired and suspending the balance in the air an inch or two above the bench. If the distance between the point where the spring is held by the tweezers and the rim of the balance is one-half inch, the spring is approximately the correct strength. It does not matter if the balance is large or small, the distance remains practically the same.

Of course, this does not necessarily decide that a particular spring is to be used, but it does eliminate all unnecessary attempts at vibrating a spring that is positively unsuited for a particular balance.

After trying several springs, finally selecting one that conforms with the above test, the next procedure is to adapt the spring to the watch. To decide on the proper diameter of the spring, lay the balance cock upside down on the bench and lay the spring thereon with the collet centered above the balance hole jewel. The coil that falls inside the inner pin shows the full diameter of the spring. Now, hold the coil that fell inside the inner pin with the tweezers and proceed to vibrate it, either by counting the vibrations or using an instrument commonly known as a "vibrator." Since nearly all watches of recent years are made with a 300 beats per minute trains, it is convenient to use the vibrator about which more will be written later. For the other trains it will be necessary to count the vibrations, using a watch of known accuracy. The counting is done with every vibration that takes place in a clockwise direction, that is, the return vibration is not counted. Thus counting for one minute, there would be 150 counts for a 300 beat train; 135 counts for a 270 beat train etc.

Vibrators may be purchased from material houses or may be made from an old balance and spring properly timed. The instrument consists of a mounted sixteen-size bal-

ance and an enamel watch dial or glass. The balance spring is fastened at such a height that the balance is suspended and the lower pivot just touches the dial. The balance will vibrate without the need of hole jewels by merely setting it in motion.

The method of using the vibrator is that of comparison, that is, watching the balance to which is fastened the balance spring to be vibrated and the vibrator balance, and note whether or not both vibrate in unison.

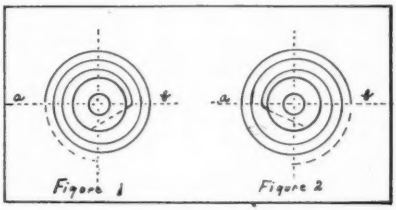

Figure 1 Figure 2

Let us assume that we have found a spring that vibrates properly. We break the spring off one quarter of a coil beyond the vibrating point. If close position adjustment is desired, pin the spring at the collet so that the inner terminal stands on the horizontal line a b as shown in Figures 1 and 2. Note that in both Figures the middle of the first half of the innermost coil stands in the direction of pendant up. The reason for this pinning is fully described in the writers paper in the October 1938 issue of the American Horologist.

The spring is now pinned in at the stud, and the balance cock with balance spring attached is placed in the watch for final timing.

Fitting the Breguet Spring

The fitting of the Breguet spring to a watch involves all of the work of fitting a flat spring except that the full diameter of spring need not be so exacting. The full diameter, however, should not be larger than one-half of the diameter of the balance including half of the screws. The Breguet spring differs from the flat spring in that the outer coil is raised above the main body of the spring and this portion is brought nearer the center in the form of a curve.

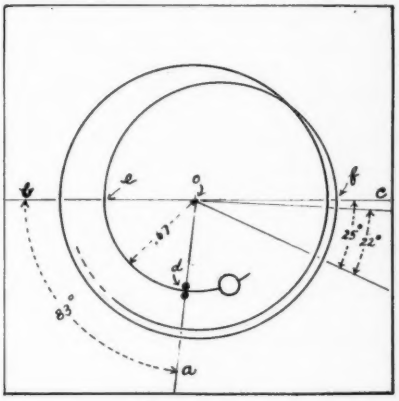

Figure 3

In Figure 3 is shown the well known Lossier outer terminal, a later development of the so called Breguet, and designed by M. Lossier, director of the Horological School of Bencanson. Its purpose is to cause the center of gravity to fall at the center of the spring thereby resulting in concentric vibrations.

To adapt this spring to a watch it is first advisable to draw a picture of the spring. First describe a circle at some convenient radius to represent the outer circle of the spring and lay off 83 degrees from the regulator pins, at a radius of sixty-seven hundreths of the radius of the spring. This distance and radius are shown between the points **a** and **b**. Starting at **b** draw a straight line thru the center of the collet to **c** on the opposite side of the collet. The curve for the over coil is composed of sections of two circles. The portion of the spring represented by the angular distance between **d** and **e** has for its center the center of the collet and that circular portion between **e**

and **f** has for its center the x shown slightly to the left of the collet center on the line **b c**. The position of x is arrived at by locating the distance half way between **e** and **f**.

After vibrating the spring in the flat and breaking off spring at the vibrating point, we must determine the length of the overcoil. For this we must resort to a bit of calculation.

Suppose we wish to make a curve represented in Figure 3. We must find the length of the portions **d e** and **e f**. The following formula gives us the length of **d e**.

$$\mathbf{d\ e} = \frac{2\ e\ o \times 3.14 \times 83}{360} \qquad (1)$$

The radius **e o** multiplied by two gives us the diameter of that part of the overcoil concentric to **o**. Hence the diameter **2 e o** multiplied by 3.14 gives the circumference, which in turn is divided by 360 to determine the length of one degree. Multiplying the length of one degree by 83 degrees gives us the length of **d e**.

Now we wish to know the length of **e f** which, when added to **d e** gives us the total length of the curve.

$$\mathbf{e\ f} = \frac{(e\ o + o\ f)\ 3.14}{2} \qquad (2)$$

Since **e o** + **o f** is half of the circumference it is only required to multiply same by 3.14 to give the circumference and divide by two.

Now taking a practical example let us suppose that the diameter of the spring is eight millimeters. The radius would be four millimeters. According to the elements of the curve; **e o** is sixty-seven hundredths of the full diameter. Thus:

$\mathbf{e\ o} = 4 \times .67 = 2.68$

Substituting this value for **e o** in equation No. 1 we have the angular distance for **d e**.

$$\mathbf{d\ e} = \frac{2.68 \times 3.14 \times 83}{360} = 3.88$$

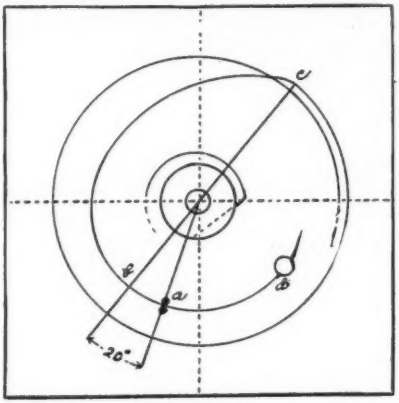

Figure 4

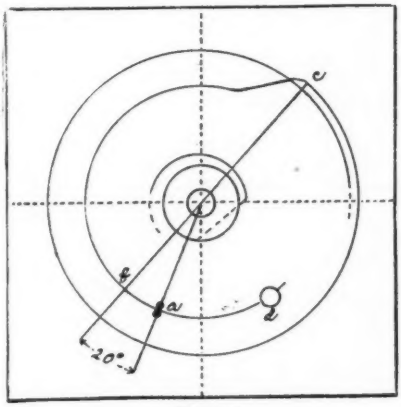

Figure 5

Substituting for equation No. 2 we have the length of **e f**:

$$\mathbf{e\ f} = \frac{(2.68 + 4)\ 3.14}{2} = 10.48$$

For the full length we add **d e** and **e f** giving us 14.36 millimeters (3.88 + 10.48).

We now grasp the spring at the point intended for the regulator pins and slide the spring along a scale in order to determine the actual length of the curve. It is permissable to make a slight mark at this point to indicate the starting point of the curve.

Raising the Overcoil

We are now ready to raise the overcoil. This is accomplished with rather heavy tweezers. Grasp the spring with the tweezers about 25 degrees from that point where the inward bend starts. Hold the spring tightly and press into heavy card board until the outer coil assumes the shape shown in Figure 7. Turn the spring over and measuring 22 degrees from the first bend, bend again until the outer coil lays level with the body of the spring (Figure 8). Bring in the raised portion so that the overcoil takes the form shown in Figure 3.

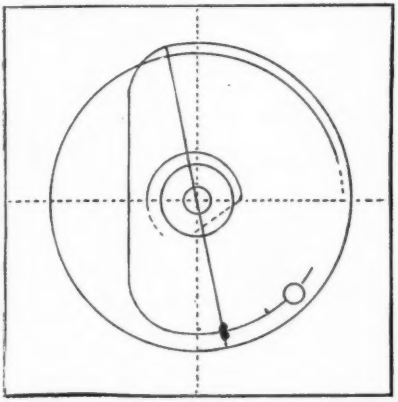

Figure 6

The Lossier curve is not adaptable to most small watches for the reason that the curve is brought in nearer to the central portion of the total mass than these watches will permit. However the above analysis may be used as a basis for calculating other forms since the length of the curve does not vary very much. The forms more adaptable to present day small watches are shown in Figures 4, 5, and 6.

In Figures 4 and 5 note that the radius of the overcoil along the path of the regulator pins is three fourths of the radius of the spring. The length of the curve is 180 degrees plus 20 degrees. Again in Figure 6, the overcoil at the regulator pins is placed in a position nearly in line with the full radius of the spring. In this type, the curve usually takes the form shown in the figure and the bend for the overcoil occurs at a point opposite the regulator pins.

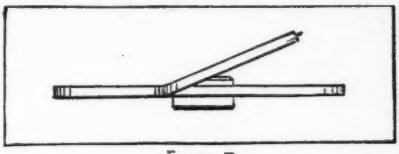

FIGURE 7

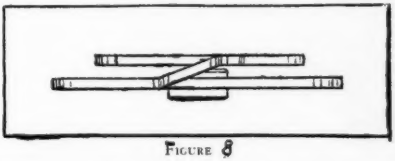

FIGURE 8

Eccentric Motion of the Spring

After a spring has been fitted to a watch an eccentric vibration may be observed, due to a faulty form of the overcoil.

The rules for correcting the eccentric motion are as follows:

(1) *If the eccentric motion takes place opposite the reglator pins (as in a flat spring) bring in part of the overcoil toward the center of the spring.*

(2) *If the eccentric motion takes place on the same side as the regulator pins move part of the overcoil back into the main body of the spring.*

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Choosing An Occupation

By RICHARD G. SELKE

In choosing watch repairing as an occupation for his livelihood, a young man considers the necessity of accurate time keeping instruments and the appeal of the scientific and artistic nature of the craft.

Due to the size, intricate parts and extremely accurate dimensions required in this work, the majority of watch owners do not fully understand all the difficulties involved to make a time piece function properly. Occasionally we hear an expression of doubt as to the honesty and ethics of a watchmaker. In comparing watch repairing with merchandising and many other crafts, a watchmaker's ability and honesty are most closely gauged by the timepieces themselves. The moment a watchmaker opens the case of a timepiece and touches a part of its movement, he is responsible for its condition and care. Any experienced watchmaker well knows that much time and material are spent to make timepieces function properly, for which he receives no compenstion. However, many young men enter the vocation of watch repairing and are hired out as repairmen in jewelry establishments before they have finished their course of instruction and have passed any examination as to qualify them to do their work adequately. Such workmen are working under a strain and much loss of energy, to turn out work such as they can. Do not condemn such a workman as dishonest, a botch and what-not; this workman was put to work dishonestly.

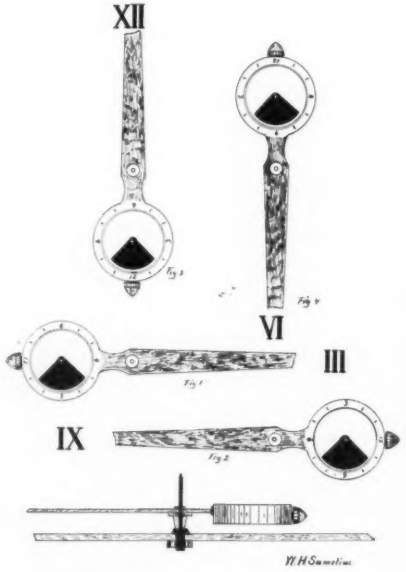
It is the aim of the Chicago Horological Guild to guide the inexperienced workman to a better understanding of our problems and to encourage him to take pride in the knowledge and skill of his craft. He should also strive to earn a certificate of his ability issued by some reputable horological society.

Mystery Clock, Or, Balanced Hands

By W. H. SAMELIUS

The mystery clock, as we know it today, dates back about 100 years, still, with each new generation, it seems to be as mysterious today as ever.

A short explanation with illustrations, will help to clear up the mystery, perhaps giving some of our young watchmakers the incentive to build one of these clocks. They are always attractive for a window display and occasionally the jeweler will offer a prize to the one who can solve the mystery of what makes the hands move.



The hour and minute hand rotate perfectly free on a central pivot. It is preferable to make jeweled bearings, reducing the friction, making the hands more sensitive to poise.

Some jewelers place an electric fan to one side of the clock so when the fan is in operation it will cause the hands to move, the fan being controlled by an automatic switch that

stops and starts the fan at intervals of five minutes, helping to make the clock even more mysterious, as when the fan is at rest, the hands will counter-balance themselves to the correct time.

The secret of the mystery clock is in the end of each hand, which contains a watch movement. In place of the watchmovement carrying hands, there is a quadrant or counterweight attached, to replace the regular hand.

For the minute hand of the clock, the quadrant is attached directly to the cannon pinion and for the hour hand it is attached to the hour wheel tube.

The balancing of the hands must be such that when the hands hang downward, as in Figure No. 2, the hands will lie in a horizontal position. When the counterweight is moved to perpendicular, shown in Figure No. 3 and No. 4, the hands will be in a perpendicular position, pointing directly to 6 or 12.

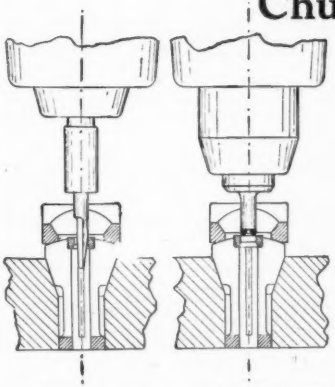
For a 16S movement, a quadrant 2½ to 3 MM thick will be sufficient to control the hands. This quadrant may be of brass.

The illustration shows winding stem and crown extending thru the case for winding and setting the movemet. To make the hands more mysterious, use a lever set movement, which would necessiate a small hole in the case for winding and seting. If a key wind movement is used, the cup can be sealed with the cover over the movement, leaving no opening for the guesser to tell just what is inside or how it is operated.

In fastening the movement to the hands, place it so the weights face the dial. This will cause the hands to rotate clockwise, while the weights rotate counterclockwise.

Watch for January 1941 Issue

Chuck and Bushing Set



Jewels now are replaced in old original settings, or set in new brass bushings easily and quickly. Set contains 12 sizes of chucks and bushings with plate for holding chucks.

Plate is free (not fastened) on base of jeweling tool, thus it can be used on ANY MAKE of JEWELING TOOL, and a perfectly centered hole is cut.

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Loose Balance Screws

By Jos. A. Beimel

Balance screws that will not hold when screwed into the balance rim are usually too small at the threaded portion or the threads may be somewhat damaged. This may also be the case with the threads in the balance rim. There are several ways to make the loose screws take hold. The repairman of course must choose the method best adapted to his particular job, depending mainly upon the particular make and grade of watch.

If a large stock of balance screws are at hand then a screw may be found that may match the one opposite but having a somewhat larger thread. If no screw is available then the threads in the balance rim may be compressed, this however requires a special tool. By far the simplest way and one that will answer the purpose for the ordinary job is to hold the threaded part of the balance screw between a pair of smooth parallel pliers and squeeze the pliers which flattens the threads on two opposite sides and will at the same time spread or increase the diameter of the untouched parts of the threads. This produces a somewhat rectangular thread. Such a thread will hold sufficiently firm to prevent the screw from coming loose providing, of course, that the threads in the balance rim are not completely gone, otherwise a new thread may have to be tapped into the rim itself.

Excellent Workmanship

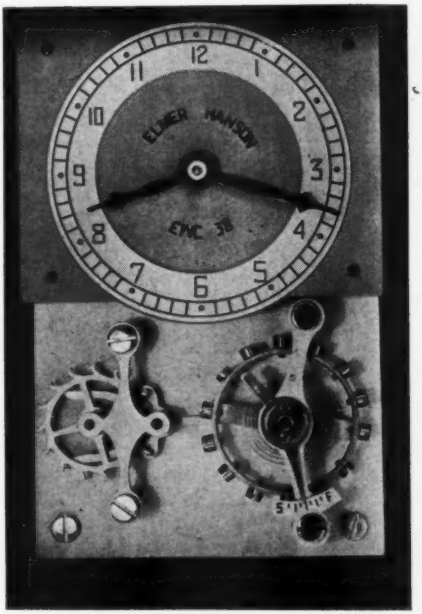
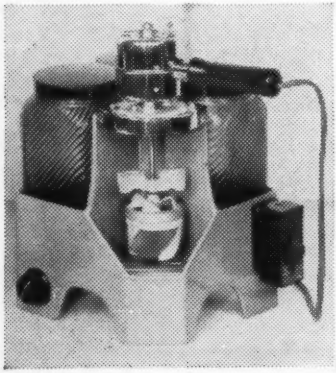


Figure .1

Fig. 1. Actual size of model is 4x6 inches, the escapement being enlarged 10 times. The train is designed and calculated so as to show correct time while balance makes 180 beats per minute.

It is nicely finished, plates being silvered and the working parts gold plated. Mr. Elmer Hanson is a student at the Elgin Watchmakers College and designed and made his own working drawings besides many special cutters which were necessary to carry on the work.



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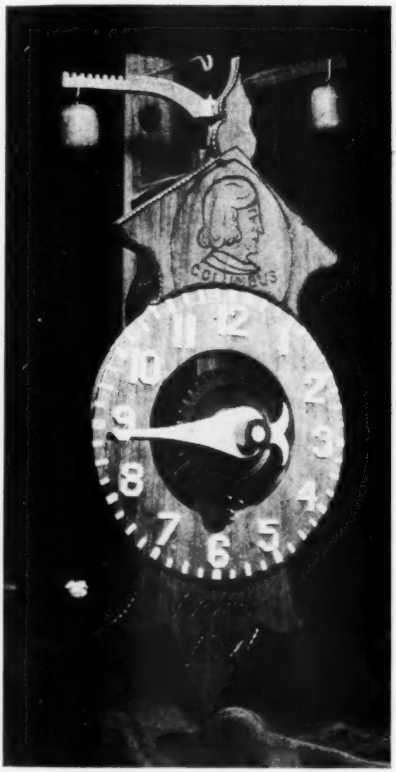

Figure 2
Fig. 2. Columbus Clock by Kenneth Jakins. This clock was built of walnut throughout, Mr. Jakins making his own working drawings and all cutters necessary to carry on the work. This clock is similar to drawings obtainable from THE AMERICAN HOROLOGIST'S files. Mr. Jakins is also a student of the Elgin Watchmakers College.

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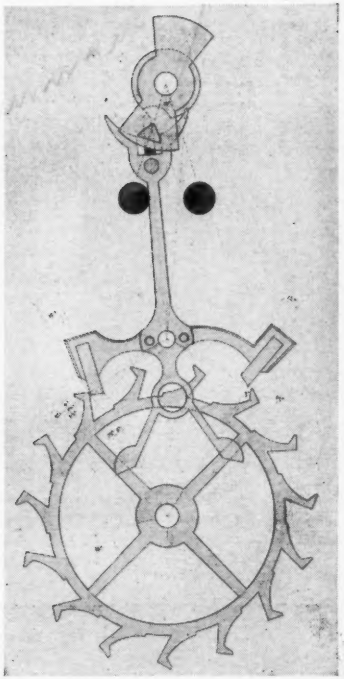

Fig. 3. Drawing by Hermann Gruninger, Detroit

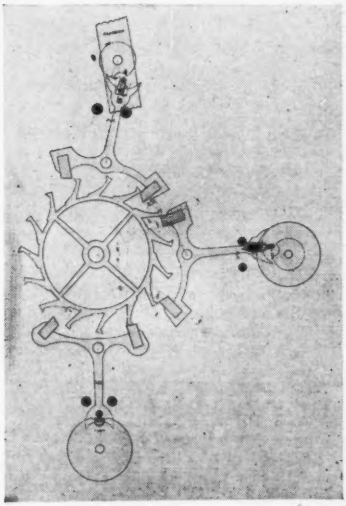

Fig. 4. Drawing by Hermann Gruninger, Detroit

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Questions

1. What is the definition of Horology?
2. How many horologists are there in the United Staes?
3. Who is considered the father of horology and why?
4. What types of training and education are necessary for horologists?
5. What are the most famous schools of horology?
6. What is the Mecca of horology? —most famous town in Switzerland?
7. The difference of watchmaking in the United States and Switzerland?
8. The average income of various types of horologists in the United States?
9. Are there any college courses anywhere on branches of horology?
10. What was the first clock built?
11. Number of watches manufactured annually in the United States.
12. How many watches imported from Switzerland, or other chief exports?
13. What is the most common motive power for clocks?
14. Is there evidence showing people once owning watches are never again without them?
15. How many wrist watches and pocket watches estimated in the U. S. today?
16. Are there any very unusual seasonal factors causing fluctuations in watch and clock volumes of the trade?
17. Has advent of radio time signals hurt volume of watch and clock trade?
18. Compare annual number of Swiss watches, assembled from imported parts, and number brought in all assembled.
19. What are the latest freak developments in the timepiece line?

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AERONAUTICAL INSTRUMENT SERVICE

Aircraft Instruments

EDITOR'S NOTE—Aeronautical Instrument Service is a subject untouched by publications in the Horological field, or in fact by any publication. In September, 1938, THE AMERICAN HOROLOGIST inaugurated such an educational service via prepared illustrated lectures to be used by U. H. A. A. organizations for the purpose of broadening our members' scope of knowledge in this field, which offered additional remuneration to those far-sighted enough to avail themselves of such knowledge.

ARTICLE NO. 15

(Continued from November Issue)

(f) Vibration.—An effect of non-magnetic nature results from excessive vibration due to roughly running engines and rigid structure or from turbulence of the air when the compass is mounted without adequate protection in the slip stream. The resilient mounting is usually adequate to prevent unsteadiness due to vibration.

Permanent magnets.

(a) Voltmeters and ammeters.—These instruments contain large permanent magnets and should be kept 12 or more inches away in order that the compass may be compensated properly. The wires leading to the electrical instruments must be kept close together (preferably twisted) so that the variable effect will be minimized.

(b) Liberty switch.—The Liberty switch incorporates an ammeter to which the above remarks apply.

(c) Pilot director, electric thermometers, induction compass indicator, etc.—These instruments also contain large permanent magnets and should be kept as far from the compass as practicable and should never be closer than 10 inches. If there are two of these instruments grouped closely together the minimum distance is 12 inches.

Starting magnetos will render the compass inactive if placed too close and should never be less than 24 inches away.

(d). When selecting a location for the compass it should be borne in mind that the magnetic effect of a disturbance will vary inversely as the square of its distance from the compass. In other words, the amount of the effect will be only a quarter as great when the distance is doubled.

(e). Generally speaking, an installation in which the compass can be compensated so that the maximum residual deviation does not exceed 10° is considered satisfactory.

Installation of compasses.—If the compass is mounted outside of the cockpit, it must be protected from the blast of the slip stream.

It must be mounted so that a plane passing through the lubber line and the pivot post is parallel to the fore-and-aft axis of the aircraft and so that the pivot post is nearly perpendicular when the aircraft is in normal flying position. The type B compasses are designed so that when the instrument board is vertical and perpendicular to the line of thrust, the above condition will be satisfied when the compass is mounted on the board. When the board is inclined, the compass should be bracketed so as to meet those conditions. Any brackets for mounting the compass should be

made of nonferrous metal such as brass or duralumin or wood. Likewise brass mounting screws and nuts must be used.

Care must be exercised that the bowl has the full range of freedom allowed by the design of the resilient mounting. In other words, it must strike no object when moved to any position allowed by the shock-absorbing system.

The location of the compass should take into account the safety of the pilot in case of a crash by mounting in a position where it will not present any unnecessary hazard. It may be mounted with a special bracket on the forward surface of the instrument board through which a round hole is cut to provide visibility of the card. Such cases require special consideration to accessibility to the compensation magnet chambers.

The lamp is to be connected to 12 volts in accordance with the wiring diagram for the aircraft, if available. If the aircraft is equipped with 8-volt system, the compass lamp may be used with this voltage for emergency purposes. Care should be exercised that the proper fuze is in series.

The compass should be handled carefully to avoid severe shocks that might injure the pivot or jewel cup or spring the card so that it will not balance properly.

A compass correction card holder should be mounted as near to the compass as practicable where it can be easily referred to by the pilot during flight.

Errors in compasses.—There are four causes for inaccuracy in compasses:

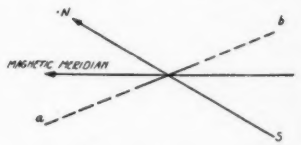
(1) Permanent and residual magnetic fields of the aircraft's steel parts.

(2) Magnetism in the soft iron induced by the earth's magnetic field.

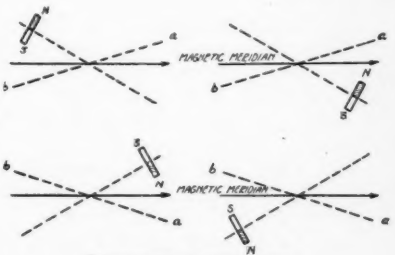
(3) Vibration.

(4) Turning motion of the aircraft.

Errors due to (1) and (2) above may be largely eliminated by compensation; those resulting from (3) above, by suitable construction; but there is no way to eliminate those caused by (4) above. While subjected to jarring or vibration in being forged, machined, or fitted in place, the steel parts of an aircraft acquire a certain amount of permanent magnetism which is induced by the earth's magnetic field. On account of vibration of the engine and shocks of gun fire and landing, this permanent magnetism will change when the aircraft is put in service. However, a certain amount always exists. The resultant field of permanent magnetism causes the compass needle to deviate from the magnetic north. The amount and direction of the deviation depend upon the angle which the permanent magnetic field of the aircraft makes with the magnetic meridian. In Figure 50 (a), **N—S** represents the direction of the resultant field of



(a) EFFECT OF AIRCRAFT MAGNETISM ON COMPASS



(b) QUADRANTAL DEVIATION DIAGRAM

permanent magnetism. The compass needle **a—b** is deflected to the west. The deviation will always be westerly (although differing in amount) so long as the **N**-end of the aircraft's permanent magnetism is east of the magnetic meridian. Thus, the devia-

tion due to permanent magnetism changes sign every 180° of change in direction of permanent magnetism and for this reason is called the semicircular deviation.

The soft iron of the aircraft is magnetized by induction from the earth's field. The direction of this induced magnetism fluctuates as the aircraft changes azimuth. If there were three bars of soft iron in the aircraft, one parallel to the longitudinal axis, one athwartship, and one perpendicular to the other two (which is nearly vertical), the effect would be the same. When vibrated the latter bar would be magnetized by the vertical component of the earth's field. Its magnetism would always be in the same direction unless the aircraft passed the magnetic equator. If the axis of this bar were coincident with the pivot of the compass, no deviation would be produced; but if it were on one side of the compass pivot, it would cause a deviation since one end is usually nearer the compass than the other. The direction of this deviation is reversed whenever the aircraft changes azimuth 180°. Hence the effect is semicircular and can not be distinguished from that of permanent magnetism.

The induced magnetism in the athwartship bar would have no effect if the aircraft were headed north, east, south, or west. For, when headed north or south, the axis of the bar would be at right angles to the earth's field and the induced field would be negligible; when headed east or west the axis of the bar would be parallel to the compass needle and would cause no deviation. The maximum effect would be at the quadrantal points, **NE.**, **SE.**, **SW.**, and **NW**. An examination of Figure 50 (b) will show that the deviation changes sign every 90°. Hence this effect is called a quadrantal deviation. The effect of the longitudinal bar would be similar but oposite in direction to that of the athwartship bar. However, its magnitude would be less and in compensation no attempt is made to separate the two.

One of the most serious errors of the aircraft compass occurs when turning off a northerly course. It is sometimes called the northerly turning error. It is due to the vertical component of the earth's magnetic field and can not be entirely overcome. If an aircraft is flying northward and makes a properly banked turn to the east or west, the card no longer remains horizontal, but tips with the aircraft, keeping parallel to the floor. This is due to the centrifugal force developed on the turn. With the card in this position the vertical component of the earth's magnetic field is allowed to act, and the **N**-end of the card tends to turn downward. On a slow flat turn, the card remains horizontal and holds its direction; and the aircraft and the lubber line turn with reference to the card. But on a banked turn from a northerly course the card turns also and in the same direction that the aircraft turns. The rate of turning for both the card and the aircraft may be the same. Therefore, if the pilot depends on the compass alone he will not appear to be turning at all. The compass card may turn faster than the aircraft. Then, it will appear to the pilot that he is turning in a direction opposite to the actual

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turn. The compass may turn slower than the aircraft. In this case the direction of turn is correctly shown, but the rate appears slower than it actually is.

On turning off an easterly or westerly course this effect does not occur. On turning off a southerly course the card tends to turn in a direciton opposite to that of the aircraft, and the aircraft appears to be turning faster than it actually is. Therefore this turning error is serious only on northerly courses. If the weather is clear, the pilot can use some fixed point for reference and can straighten out his course and hold the craft level until he obtains a constant compass reading; but when flying in clouds with no fixed reference point the action of the compass is so misleading that the pilot may fall into a spiral that generally leads into a tail spin. For this reason some pilots believe that clouds are magnetic and produce large deviations of the compass.

The period of a compass is determined by the strength of the card magnets. A short-period compass has strong magnets, a long-period compass weak magnets. The northerly turning error for a compass with a period of 10 to 15 seconds causes the card to turn at a rate greater than that of the aircraft, while that for a compass with a period of 40 to 50 seconds causes the card to turn at a rate less than that of the aircraft. Hence a long-period compass would be better for cloud flying if it were not so sluggish in registering turns. As it is, it is better to use a short-period compass and equip the aircraft with a turn indicator. The turn indicates a turn independently of the compass and enables the pilot to hold a straight course or to straighten out from a turn.

Compensation of airplane compasses.—Swinging base.—The process of compensating compasses on aircraft and obtaining the final deviation at the various points is called swinging the airship. For this purpose every permanent flying field should be equipped with a circular concrete platform having a radius at least equal to the length of the largest airplane to be swung. The platform should be situated not less than 75 yards from any aircraft and at least 100 yards from any steel structure, such as hangers or railroads. Starting with the magnetic north, radii should be laid out every 30°. For airplanes it is also convenient to have a dolly for elevating the tail skid, the airplane then being approximately in flying position. The dolly must be rigid and strong enough to hold the

(Continued on Page 24)

AEROPLANE AIRSCREWS

E. Molloy, Editor

1940 $2.00

99 Illustrations **Cloth Bound** **132 Pages**

The de Havilland Controlled Pitch Airscrew and the Hydromatic Airscrew are the subjects of this book.

The detailed operations which are entailed in dismantling, servicing and reassembling of component parts have been described with a wealth of diagrams and specially staged action photographs.

A special section has been devoted to the electrical control which is employed in connection with the Hydromatic airscrew.

Several interesting charts are included which show in graphic form the mechanical "raison d'etre" for the use of variable pitch airscrews. This feature will, we believe, be particularly appreciated by the many thousands of engineers who can grasp the significance of a chart much more readily than they could follow the abstruce mathematical calculations which such charts may embody.

The keynote of the treatment of this book is "direct utility to the ground engineer and air mechanic".

Book Dept. The American Horologist

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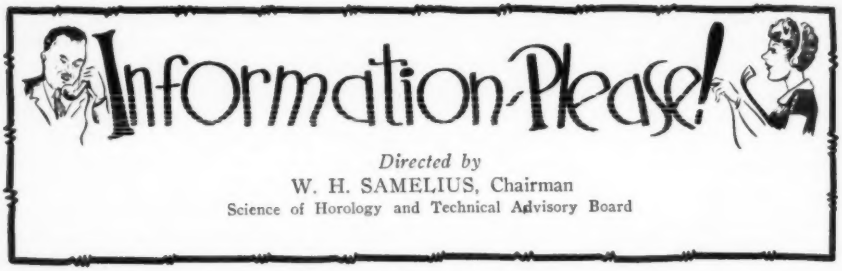

Directed by
W. H. SAMELIUS, Chairman
Science of Horology and Technical Advisory Board

E.L.S.—In a recent discussion, it was claimed the now extinct Illinois Watch Company was one of the oldest watch companies in America, if not the oldest. Can you give a short history on the Illinois Company?

Answer—Preliminary organization work of the Illinois Watch Co., was begun in 1869 by John C. Adams, who interested local capital in the proposed company, work starting on the building in December, 1869. The plant was tooled in 1870, production beginning in 1871 and the first watch was completed in 1872 (January). They were 18S, full plate, key wind and were named Stewart, Bunn, Miller, Currier, Hoyt and Mason. In 1873 the factory employed 125 people, making approximately 25 movements per day. There were many watch companies in existance prior to the organization of the Illinois Watch Company.

H.G.F.—In repairing house clocks, I find different forms of striking trains. Some have count wheels, others, a rack and snail. Which of these ideas are the earliest?

Answer—The count wheel, substantially as used today, is found on clocks which were built before dials and hands were invented. It was used to strike the hours on a bell. (Cloche) from which the clock got it's name. The rack strike was invented by Edward Barlowe in 1675. It was placed between the plates about 1700 and is still found there in some makes of French clocks. The English always placed it on the outside for greater accessibility.

T.O.W.—In reading a text book, I find a "sand bath" mentioned. What does this mean?

Answer—Objects which are difficult to heat evenly, such as clock hands and other long thin pieces, are frequently blued after hardening by burying them in the sand and then heating the sand until the desired color is obtained. The sand bath is also used in chemical laboratories where a well distributed low heat is desired.

J.H.P.—Can you give me the definition of "Invar" and "Elinvar." Are these trade names or are they derived from Latin?

Answer—They are trade names to designate 36% nickel steel and are abbreviations of "invariable" and "elacticity invariable."

A.R.T.—What is the proper procedure in testing a watch for isochronism?

Answer—The isochronism test consists of readings every three hours until the watch runs down. This shows how the rate varies according to the time elapsed since winding.

B.F.R.—I notice, in fine watches, gold trains are used. Are they better than brass trains?

Answer—Gold trains are not as good as brass because gold is softer and more liable to injury. So-called gold trains are made from stock which has a thin sheet of gold soldered to each side and rolled out. In other words, it is simply gold filled

stock, or rolled plate stock with a base metal of very stiff and hard rolled brass.

O.E.T.—On many auto and mantle clocks, I find two spring barrels for a single train. How so?

Answer—Trains with two barrels are usually designed for an eight day run, using long springs. With two barrels, the springs can be much thinner and longer than if one were used, so that the difference in power between springs wound up and nearly run down will be much less than if a single spring having the same pull were used. Barrels are usually placed on the opposite sides of the center arbor and therefore one offsets the side thrust of the other, giving less friction on the center pivots.

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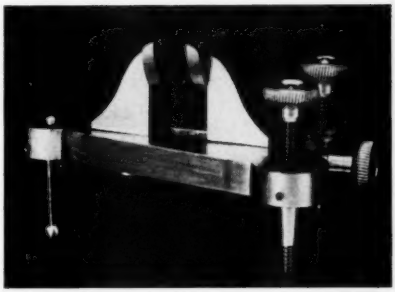
Poising Tool



The accompanying illustration of a medium size agate jawed poising tool, made by Mr. Robert James, student of Elgin Watchmakers College.

Due to the shortage of poising tools on the market, Mr. James decided to make his own tool. Besides being a good mechanic, Mr. James also has a hobby of stone cutting, which came in good play in making the agate jaws for this tool. Mr. James is to be commended for this fine piece of workmanship.

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AERONAUTICAL INSTRUMENTS

(Continued from page 21)

airplane while the engine is running at half throttle. There should also be a pair of single-wheel blocks. It is well to have a couple of 50-pound sandbags to put across the rear of the fuselage of nose-heavy airplanes.

At temporary flying fields and wherever the above-described equipment is not available a swinging base can be laid out on a hard, level plot of ground of sufficient size to suit the types of airplanes to be swung.

Procedurees.—Procedure I.

(a) Elevate the tail on the dolly until the airplane is approximately in flying position.

(b) When necessary, put the weights across the rear of the fuselage.

(c) Place the center of the landing gear over the center of the swinging base.

(d) See that there is no lateral inclination of the airplane.

(e) Head the airplane north by sighting along the fuselage and the **N-S** line, and by checking on the wheels or leading edge against the **E—W** line.

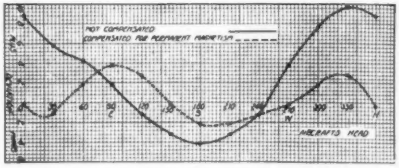
(f) Block the wheels tightly; then start the engine, being sure that the propeller clears the concrete.

(g) Ascertain that all moveable steel and iron parts are properly placed for flight. If the control column or rudder pedals are made of magnetic material, they should be held in the neutral position at each setting.

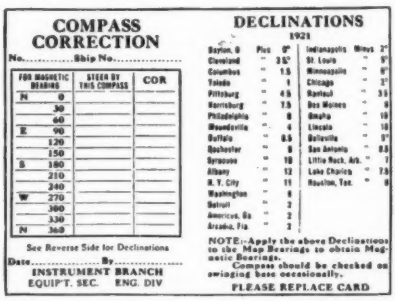
(h) Empty the compensating chamber of all magnets. Keep all unused corrector magnets fully 1½ feet from the compass during all operations.

(i) Run the engine on each heading at about 600 or 800 revolutions per minute for single-engined airplanes. The running of the engine does not affect the compass except when single ignition wires are near the compass on airplanes of the twin-engine types. On tri-motor airplanes only the center engine need be running during the process.

(j) 1. For the first compensation, place the airplane with the longitudinal axis on the magnetic meridian; that is, with the fore-and-aft axis parallel to the **N—S** line. There are furnished with



each compass three sizes of compepensating magnets, one thirty-second, one-sixteenth, and three thirty-seconds inch diameter. Their strength is roughly proportional to the diameter. Put a sufficient number of these magnets into the compensating chamber which is at right angles to the magnetic meridian to reduce the easterly or westerly



COMPASS CORRECTION

No.....Ship No.....

FOR MAGNETIC BEARING	STEER BY THIS COMPASS	COR
N 0		
30		
60		
E 90		
120		
150		
S 180		
210		
240		
W 270		
300		
330		
N 360		

See Reverse Side for Declinations

Date.....By.....

INSTRUMENT BRANCH
EQUIP'T. SEC. ENG. DIV

DECLINATIONS
1921

Boston, Mass.	Plus	0°	Indianapolis, Ind.	Minus	2°
Cleveland, O.	"	3½°	St. Louis, Mo.	"	5°
Columbus, O.	"	1.5	Minneapolis, Minn.	"	9°
Toledo, O.	"	1	Chicago, Ill.	"	3°
Pittsburg, Pa.	"	4.5	Rantoul, Ill.	"	3.5
Harrisburg, Pa.	"	7.5	Des Moines, Ia.	"	8
Philadelphia, Pa.	"	8	Omaha, Neb.	"	10
Moundsville, W. Va.	"	4	Lincoln, Neb.	"	10
Buffalo, N. Y.	"	8.5	Belleville, Kan.	"	9°
Rochester, N. Y.	"	8	San Antonio, Tex.	"	8.5
Syracuse, N. Y.	"	10	Little Rock, Ark.	"	1
Albany, N. Y.	"	12	Lake Charles, La.	"	7.5
N. Y. City	"	11	Houston, Tex.	"	6
Washington, D. C.	"	6			
Detroit, Mich.	"	2			
Americus, Ga.	"	2			
Arcadia, Fla.	"	3			

NOTE:—Apply the above Declinations to the Map Bearings to obtain Magnetic Bearings.
Compass should be checked on swinging base occasionally.

PLEASE REPLACE CARD

deviation to zero. Then set the airplane along the **E—W** line and correct the northerly or southerly deviations by placing magnets in the compensating chamber which is at right angles to the first compensating chamber. The deviation for this position is generally greater than that for the north and south heading and,

if the compass is near the engine, so many magnets will be required that the use of the extra compensating chamber below the compass will be necessary. Having corrected the deviations for these two points, the semicircular deviations for all points should be nearly or entirely eliminated. If no further compensation is desired, determine the remaining deviations by placing the airplane on the **N—S** line with the nose north; then, on the 30° line; then 60°, and so on around the complete 360° of the circle. At each point, note and record the reading of the card in degrees. Prepare a table or chart giving the compass reading for each of these points. Figure 51 illustrates the deviation before and after compensating of a compass in the rear cockpit of a DH-4 airplane. Figure 52 illustrates a form used for recording the remaining deviation and for reference in reading the compass during flight. The difference between the readings of the second and first columns in Figure 52 gives the correction as listed in the third column. In order to obtain the true or map bearing of an aircraft, the declination must be added to or subtracted from the magnetic course; added if the declination is east and subtracted if west. For example, using the compass for which the chart in Figure 51 was prepared, in order to fly magnetic E (90°), the airplane must be so headed that the compass reads 94°. In the vicinity of Washington, D. C., where the declination is about 6° W., the true bearing will be 96°; to fly true E., the compass must read 100°.

(Continued—January 1941)

"The Pathway to Success"

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JEWELRY
STONE SETTING
ENGRAVING

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School of Horology
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Established 1886

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Ship to us for highest returns-fastest service

Grand Rapids Guild

Elected new officers at a recent meeting. The officers are as follows:

President—T. F. Barnes
Vice-Pres—Ray Johnston
Secretary—Ray Heinzelman
Treasurer—Boyd Ruhlman

T. F. Barnes
President

Ray Johnston
Vice-President

Ray Heinzelman
Secretary

The guild held a dinner meeting on November 8, with over 50 present.

The guest speakers were Mr. W. H. Samelius and Charles Fetter.

COSLEY JEWELRY COMPANY

Wholesale Dealers of

Jewelry, Tools and Jewelers' Supplies, Findings, etc.

301-302-303 University Building
Denver, Colorado

LANDAW BROTHERS
Watch Material & Jewelers' Supplies
406 Clark Building, Pittsburgh, Pa.

Well Said

There never was a professional or business man who didn't profit in some measure from contact with his fellow professionals, or craftsmen; Horology is no exception.

"What Horology needs most today is not only the moral, but the financial and militant support of its educational and research institutions on the part of the retail Jewlers and Watchmakers."

Worcester County Guild No. 2

The Worcester County Guild in Massachusetts held their regular monthly dinner meeting, November 4, in the Aurora Hotel. President W. D. Hebert presided.

Mr. J. Harvey Gordon spoke on "How to Identify Stones."

The next meeting will be December 2.

J. Edward Bogage, Secy.

Northern Colorado Watchmakers Guild

Colorado watchmakers' guilds and association are making splendid progress.

At a meeting held at Greeley, November 24, presided over by state officers and a delegation from Denver, new officers were elected for the Northern Guild as follows:

President—Fred Weiss, Greeley
Vice-Pres.—M. R. Simmons, Greeley
Vice-Pres.—R. E. English, Longmont
Vice-Pres.—Frank Hutchinson, Fort Collins
Vice-Pres.—Eugene H. Weiss, Loveland
Secy-Treas. — Chas. W. Garretson, Greeley.

The next regular meeting of the Northern Watchmakers Guild will be held in Fort Collins.

Northen Indiana Watchmakers Guild

Held their banquet at Lake Hotel, Gary, Indiana, November 13.

Over 150 watchmakers and their wives attended this meeting.

There were many outstanding speakers and Mr. A. S. Rowe, President of the State Board of Examiners gave a fine report of the Board's activities during the past year. Mr. Rowe encouraged early renewal of their licenses.

Arkansas Valley Guild

Held their last meeting in Newton, November 6.

The first lesson of the Horological course was started, and much interest was displayed.

Officer elected was President—P. E. Loomis, Newton.

Mr. Ed Marshall transferred from Arkansas Valley Guild to Five County Guild, and he was appointed secretary of the Five County Guild.

Minnesota Master Watchmakers' Association

Held their annual state convenvention November 3.

There were favorable reports from South Western Guild, Western Minnesota Guild, Duluth Guild, St. Paul Guild, and the state director from Minneapolis.

Mr. B. W. Heald, Chairman of U. H. A. A. Executive Board gave a very fine talk and answered questions in regards to the Licensing Law. Minnesota will definitely present their bill this coming year.

Officers elected for 1941:

President—W. W. Luce, Duluth
Vice-Pres.—W. C. Westphal, Minneapolis
Secretary—C. W. Gaskill, St. Paul
Treasurer—Carl Berger, Tracy
Directors—Herbert Witte, St. Paul; A. M. A. Hanson, Dawson; F. A. Ohleson, Marshall; and L. C. Dewey, Minneapolis.

Sioux City Horological Guild

Held their first meeting of the season at West Hotel, November 5, with the largest attendance ever had at any meeting.

It was ladies' night, with an orchestra present, a wonderful dinner, plenty of good speakers, and good food.

Atlanta Watchmakers Guild

November 12th meeting was well attended with guests from several nearby and distant towns.

A vote of thanks was extended to the Ewing Brothers and Atlanta branch of Swartchild & Company for their generosity in supplying refreshments for the first three meetings of the guild.

Harley Strong
Pres. Atlanta Guild

W. F. Chapman
Vice-President

B. F. Beasley
Secretary-Treasurer

Changes in the constitution and by-laws relative to the acceptance of membership was adopted.

Officers now in office shall remain until April 1942.

Mr. J. J. Scheff, with Ewing Brothers, and George Newton, with the Jewelers' Supply Company, and Roy Stern, Manager for Swartchild & Company were made honorary members of the Atlanta Guild.

Allegheny County Guild No. 1

At their regular meeting, November 6, elected the following officers for 1941:

President—Carl V. Carlson
Vice-Pres—Harold Krosney
Secretary—J. P. Sommer
Treasurer—Virgil Petrocelly

Horological Society of New York

Held a meeting November 5 and outlined the coming events, their annual banquet and dance to be held on Washington's birthday, February 22, and Mr. Samelius' appearance before the Society on December 3. Mr. Samelius will lecture on the subject of gearing.

Mr. Park gave his report on his visit to the New Jersey Watchmakers Association, and predicted that New Jersey's attempt to secure licensing of watchmakers would soon be realized.

The society's history is being delved into and it was found the organization was established 75 years ago. The National office has a copy of the original by-laws in German, also translations in the English.

Capitol City Guild

Ted Dilges
State Secretary, Iowa

Des Moines, Iowa watchmakers met November 17 under the direction of the state officers, who met with them, and formed the Capitol City Guild.

Temporary officers are as follows:

President—Harry Clark, Des Moines

Secretary—Ray A. Wiley, Des Moines

The next regular meeting will be December 4.

The Capitol City Guild promises to be a strong functioning body in a live state organization.

Sarasota-Bradenton Watchmakers Guild

Under the guidance of the St. Petersburgh Horological Guild, Florida will soon be a powerful state with guilds in every section.

This new guild was created November 3, and the following officers elected:

President—E. L. Wiederkehr, Sarasota

Vice-Pres.—W. K. Lee, Bradenton

Sec'y-Treas. R. E. Wadsworth, Bradenton

Ohio Watchmakers Convention

The Ohio Watchmakers Association will hold their 1941 convention March 15 and 16, 1941 in Columbus, Ohio—the Garden Spot of the World, according to the state president, Les Heimberger.

Columbus Guild

Had their election of officers for the year 1941, with the following officers elected.

President: A. W. McCabe
Vice-Pres.: Thomas France
Sec'y-Treas.: Lee Luce

Cincinnati Guild

Cincinnati continues to hold their interesting meetings.

At the meeting of November 1 the dance and other committees made their reports. Mr. Frank Foegler announced they were ready to enroll members into the Ohio watchmakers legislative society, a novel program for increasing revenue for their legislative work.

Mr. Hoffer demonstrated his polishing tool, which caught the eye of all those present.

Great enthusiasm was displayed in the new educational program, "Science of Horology."

Elmer G. Fisher Corres. Secy.

Duluth Masterwatchmakers Association

Re-elected W. W. Luce as president; Fred Nold, vice-president; and H. W. Schmidt, secretary and publicity chairman; and J. Arnold Johnson, treasurer.

Mr. J. Buskala of Cloquet and Walter Luck were elected directors for a three year term.

Mr. C. Erickson of Two Harbors and W. Kovero of Duluth are hold-over directors.

President Luce announced that for the national convention, to be held in Duluth, June 22-23-24, at Hotel Duluth, plans are being made to accommodate the reception of over 1,000 visitors.

H. W. Schmidt, Secy.

Watchmakers Association of New Jersey, Inc.

Held their annual convention October 20, Newark, New Jersey.

Much progress was reported and the plans for entering legislation were outlined.

Some of the outstanding speakers at this meeting were: Mr. J. P. Sommer, President, U.H.A.A.; Col. Wm. H. Bright, Vice-President, U. H. A. A.; Mr Andrew Park, President of the Horological Society of New York; and Mr. H. B. Fried, Secretary, Horological Society of New York.

Northwest Watchmakers Guild No. 4

At their November meeting held in Ringwood, Oklahoma, Mr. Lester Patterson, member of their organization, had arranged for a chicken and noodle banquet, which was a surprise to all members—and greatly enjoyed.

Mr. Patterson has been confined to a wheel chair all his life, but in spite of this handicap he has proven to be one of the most faithful and loyal members of the organization. He has never missed a meeting, regardless of weather or distance.

Robert. E. Reneau

Northwest Iowa Horological Guild

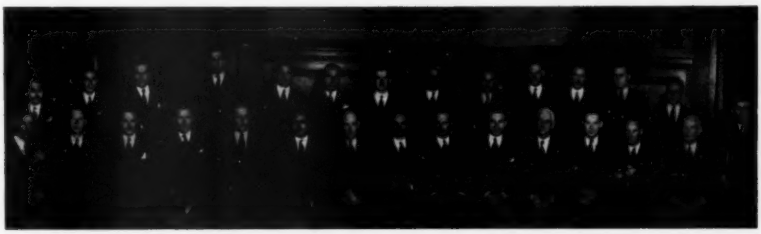
During their meeting of November 19 elected the following officers:

President—F. E. Adams, Boxholm
Vice-Pres.—R. L. Wicker, Ft. Dodge
Secy-Treas.—O. F. Sternitzke, Fort Dodge

Directors:

Andrew Arent, Rutland
E. L. Berner, Fort Dodge
Harold Berg, Manson
John Lucey, Storm Lake

Motion pictures of the Westclox factory were enjoyed by all. Their next meeting will be held January 21st at the Wahkonsa Hotel.



Front Row, Seated, Left to Right Paul M. Ginter, Frank Manning, Peter Bea, Walter Rentner, James Hoffmeier, Andrew Strohlein, J. P. Sommer, Harry Van Laar, Col. Wm. H. Bright, William C. Smith, Andrew Park, H. P. Fried, Charles Fetter, and Michael Janes.

Top Row, Standing, C. J. Miller, Kurt Jerneizig, W. Kaiser, Albert Englehardt, Christian Maier, Manuel Adler, Henry Lerner, Herman Bernstein, Samuel Greenglass, Robert Van C. Davies, Robert Halpern, Charles E. Manz and Raymond Samplawski and M. Rosen.

National Watch Collection

National Museum Committee, under the chairmanship of William H. Samelius, announces that this committee shall bend every effort to complete a collection of all American movements, showing the progress of the American industry since its inception, which would be definitely in keeping with our American organizations.

The chairman informs us that they will not refuse any foreign antiques, but do stress all American products.

All members and those who are interested in building such a collection for the National Organization, to be used at all displays, giving due credit to all donors, may forward their pieces to the National headquarters, Care of the National Museum Committee. These displays will be shown at each and every national convention, as well as state conventions or private showings.

In Memory

In memory of our departed brother, Joseph A. Schwarz, who passed away Tuesday, November 19, 1940 in the jewelry store of B. A. Gehring, Sterling, Illinois.

Mr. Schwarz was 54 years of age, had spent 35 years in the wholesale jewelry and material and supply business, had been with Henry Paulson & Co. for nearly 20 years.

He took an active part in all horological activities and started the work for licensing of watchmakers in Illinois.

Departed

Mr. Fred L. William, Sr., prominent Atlanta Watchmaker and jeweler passed away, October 25, from heart failure. Mr. William was 72 years of age, having been in the jewelry business more than fifty years, and recently celebrated his 45th anniversary as an Atlanta, Georgia watchmaker.

New York To See First Fashion Show Of Amercian Designed Diamond Jewelry

New American cut and styled diamond jewelry, especially designed to embellish the made-in-American fashions which have replaced Paris style creations, will be introduced at a formal showing in New York on Tuesday, Nov. 12. It will be the first style show devoted entirely to diamonds.

Since the invasion of Belgium and Holland destroyed the diamond cutting industries in Antwerp and Amsterdam last spring, New York has become the world's most important diamond cutting center. Jewel styles which formerly originated in Europe will be set in New York this year.

Participating in the showing for the fashion world at the Ritz-Carlton Hotel will be four leading Fifth Avenue jewelers—Black, Starr & Gorham; Cartier Inc.; Marcus & Co.; Udall & Ballou—and De Beers larger stones set more simply, and greater emphasis on utility in the form of matching pieces which can be worn individually as clips or joined together to form a single large ornament.

To be featured among the American trends are Consolidated Mines Ltd., the world's largest producer of diamonds.

Keep Your Crystal Stock Up

C. & E. Marshall Co., announces they are now distributing and have ready for delivery, 96 latest shapes and sizes of Watch-Craft and Permatex Crystals to fit the latest fall models released by American Watch Manufacturers and Watch Importers of Swiss movements—models the jewelers are now selling for the Holiday season. These crystals have been so developed that they are exact duplicates of the crystals that came with the watches as they have been custom-made to fit each individual bezel. Some of the watches, these Watch-Craft and Permatex Crystals will fit, are BULOVA'S President models, American Eagle models, Goddess of Time models; ELGIN'S new numbers such as 5008, 5508, 5704, 3906; GRUEN'S popular Verithin, Nimrod, Airman, Greyhound and the Curvex Clarion; others are the HAMILTON, Arlene, Russel, Vincent; BENRUS' Ace, Angel, Drayton; WALTHAM'S Wesley, Leona and WESTFIELD'S Ashton and

Clifton.

Going a step further than most, Marshall's have not only come out with crystals to fit more of the Holiday watches this year, they have also divided them into two series that of "Most Popular" and "Semi-popular" styles to aid the jeweler further in their advocated STOCK CONTROL OF WATCH CRYSTALS, which has met with such high favor from the trade—Marshall's stock control system keeps you constantly informed regarding newest models as well as discontinued numbers that are becoming inactive so that your stock can be kept at a minimum of expenditure yet have crystals to fit your needs—A SERVICE OFFERED BY NO OTHER COMPANY.

Time Keeping Laboratory Enlarged

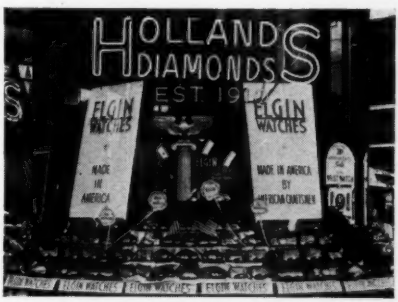
The Elgin National Watch Company has enlarged its timekeeping laboratory, located in the astronomical observatory in Elgin, in which all Lord and Lady Elgin watches are timed and rated before they are awarded Elgin Observatory Certificates for timekeeping accuracy.

The improved quarters were erected at a cost of about $10,000 and the staff of operators increased. The new rating department is an expansion of the department which is housed in a portion of the observatory buildings.

The company maintains its own astronomical equipment and observatory to provide a scientific basis for timekeeping in accordance with its motto "Time from the Stars." Here several night observations are made every week and are then transformed into exact sidereal and solar time on master clocks. This is recorded and broadcast to the world at large and directly to the work benches in the adjoining watch factory in the form of time signals which are used as a standard for Elgin craftsmen. Elgin time as computed at the observatory also serves as an accurate timekeeping source for the operation of clocks, time indicating apparatus and for the electric impulses that operate domestic electric clocks in many cities. The time beats are relayed by radio and by telephone or telegraph to far distant points. Elgin is the only fine watch factory maintaining its own equipment of this sort.

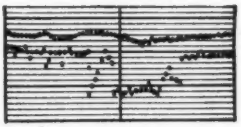
TIME FROM THE STARS TO YOUR ELGIN!

A view of the new enlarged quarters in the Elgin Watch Observatory where all Lord and Lady Elgin watches are given rigorous timing tests before being awarded the Elgin Observatory certificate for timekeeping accuracy. Located in the observatory building where Elgin takes "Time from the Stars", the watch laboratory uses time signals from the master astronomical clocks for checking the rating of every one of these fine watches. The inspection laboratory staff was increased when the department was enlarged.



Here is one way that a retailer exploited the national "American Watch" promotion of the Elgin National Watch Company for its own advantage. The picture of the show window of the Holland Jewelry Company at Sixty-Third and Halsted Streets in Chicago illustrates the local use that institutional advertising can be put to. It is tied in directly with Holland's retail display at the time of their thirtieth anniversary sale recently. It also associates the firm's stability with Elgin's well-established traditions in the watch industry.

24 HOUR RECORD
OF WATCH PERFORMANCE
MADE IN 30 SECONDS



THE CHART, compact, convenient. The actual size is only 2 inches by 1 inch. Shows the cause of irregularity in any watch (in this case, faulty escapement.) The chart also indicates the daily gain or loss calibrated to fractions of a second.

THE MACHINE, at the right, complete in one unit. Plugs in on any light socket. It tests watches of any beat in any position. Designed for unsurpassed accuracy and dependability.

Watch Master

The Watch Master is used by Bulova, Elgin, Gruen, Girard-Perregaux, Hamilton, Longines, Movado, Racine, Tavannes and other manufacturers, also the U. S. Army, Navy and Customs Departments as well as Jewelers and Repair Shops throughout the world.

Write for Sample Charts, Prices and Terms.

American Time Products, Inc.
580 Fifth Avenue **New York, N. Y.**

Distributor of Western-Electric Watch-rate Recorders.